The depicted system **20** provides a further advantage in that it utilizes a HeNe wavelength as a reference wavelength. Thus, there is no need to take preliminary steps, as may be required with other calibration apparatus, to standardize its operation with a more accurate, or standard reference. Since the system **20** utilizes the Iodine stabilized HeNe wavelength, which wavelength is commonly accepted as a secondary standard reference to the cesium fundamental time standard, the displacements generated with the system **20** can be considered to be obtained directly from a reference standard, and thus uncertainty due to calibration hierarchy is minimized.

It follows that a system and an associated method have been described which accomplish the intended purposes and objectives of the invention. Each of the described system and method utilize Fabry-Perot interferometry (with an expandable etalon cavity) and a micropositioning stage to obtain ultra-small displacements of a target with a high degree of accuracy and over a relatively broad dynamic range. In fact, if a frequency counter is used which is capable of distinguishing a change in beat frequency (of the mixed beam) which is on the order of about 30 GHz, the accuracy and dynamic range of the system will enable the calibration of conventional high-precision instruments which are not currently certified.

It will be understood that numerous modifications and substitutions can be had to the aforedescribed embodiments without departing from the spirit of the invention. For example, although a calibration operation performed with the aforedescribed system **20** has been shown and described as involving a displacement generated by the etalon **42** and amplified through the micropositioning stage **28**, a displacement could be utilized for calibration purposes through the etalon **42** alone. To this end, there is illustrated in FIG. **2** a protuberance **96** provided in the portion of the stage **28** disposed adjacent the cavity end **46** of the etalon **42**. For purposes of calibrating a device with the etalon **42** alone, the target capable of being displaced through a known increment could be provided by one side of the protuberance **96**. Displacements obtained in this manner will be as accurate as those generated with the etalon/stage assembly, but the dynamic range of displacement of the etalon alone will not be as large and may, instead, be limited to between about 1×10^{-12} m and 3×10^{-5} m.

Furthermore, although the system **20** has been shown and described as being utilized for generating a displacement for calibrating purposes, a system in accordance with the broader aspects of the invention can be used for other purposes. For example, there is shown in FIG. **4** an etalon/stage assembly **100** which can be used in place of the etalon/stage assembly **43** depicted in the system **20** for effecting a desired indexing or displacement between two objects from a reference position along any of three coordinate axes. To this end, the etalon/stage assembly **100** includes a stage **102** and two etalon assemblies **104** and **106** positioned in the stage **102** at a right angle to one another. The depicted stage **102** is adapted to generate a displacement of its platform, indicated **112**, relative to its frame, indicated **113**, along either of the indicated X and Y coordinate directions as the etalon assemblies **104** and **106** are adjusted in length. Control of the length of the etalon assemblies **104** and **106** can be had with laser beams **108** and **110** directed through openings provided in two sides of the stage body.

A sample carrier **122** is supported above the stage platform **112** so that as the platform **112** is displaced along either (or both) of the X and Y axes, the sample carrier **122** (and an object **128** mounted thereon) is displaced along the X and Y axes by an identical amount. A third etalon assembly **114** is arranged along the indicated Z-axis and suitably supported at one end to the underside of the second platform **116** so that a sensing probe **126** (either a STM or an AFM probe) mounted at the opposite, i.e., lower, end of the etalon assembly **114** is disposed adjacent the sample carrier **122**. The etalon assembly **114** is adapted to receive a third laser beam **118** directed in one end thereof by way of a mirror assembly **120** associated with the second platform **116**. It follows that by controlling the length of each of the etalon assemblies **104**, **106** and **114**, the sample carrier **122** (or an object **128** mounted thereon) can be displaced relative to the frame **113** of the stage **102** with ultra-high accuracy along the X and Y axes and the sensing probe **126** can be used to sense dimensional detail along the Z axis.

Further still, although the aforedescribed system **20** has been shown and described as being utilized for calibrating a probe **24** adapted to contact a target area during operation, an instrument which employs an alternative probe, such as a capacitive (non-contact) probe, can be calibrated with the system **20**. In fact and due in large part to the accuracy of the system **20** over such a relatively broad dynamic range, i.e., 1×10^{-12} m to about 1.0 mm, the system **20** can be used to calibrate scanning-tunnelling microscopes, atomic force microscopes, high-precision capacitance gauges, air bearing LVDTs, and optical interferometers. Accordingly, the aforementioned embodiments are intended for the purpose of illustration and not as limitation.

I claim:

1. A system for generating a desired displacement of an object with ultra-nigh accuracy wherein the object is movable from a reference position, the system comprising:

a Fabry-Perot etalon including a tube cavity having two ends, a length between the ends which is adjustable from a reference condition, and a pair of spherical mirrors disposed adjacent the ends thereof having a reflectivity of at least about 99.99% so as to provide the etalon with a relatively high reflectivity finesse, and the tube cavity being disposed in the aconfocal configuration and being arrangable in relation to the object so that an adjustment in length of the tube cavity effects a corresponding displacement of the object from a reference position; and

means for controllably adjusting the length of the etalon cavity so that in order to provide a desired displacement of the object from a reference position, the length of the tube cavity is adjusted by a corresponding amount.

2. The system as defined in claim **1** further comprising a micropositioning stage having a platform and a stage which are attached to one another for movement of the frame relative to the platform, and

the tube cavity is connected generally between the platform and frame of the micropositioning stage so that an adjustment in length of the tube cavity effects an amplified movement of the frame relative to the platform wherein the magnitude of displacement between the frame and the platform corresponds with the change in length of the tube cavity